A Comparison of Amateur Radio Digital Voice Systems

presented by

Charlotte Digital Radio Group

March 14, 2015

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Topics

- Digital voice description
- Technical comparison
- Operational features
- Programmability
- Radio choices
- Charlotte DV repeaters
- Information sources
- Q & A

ARRL — Advancing the Art and Science of Radio Since 1914
QST
DEVOTED ENTIRELY TO AMATEUR RADIO
April 2015
WWW.ARRL.ORG
DIGITAL EDITION
2014 W1AW Portable Operations: A Fond Look Back
Page 72
QST reviews:
FlexRadio Systems
FLEX-6300 and
FLEX-6700 Transceivers
DIGITAL FEATURE
56 | See a Video Overview of the FLEX-6300 Transceiver
58 | See a Video Overview of the FLEX-6700 Transceiver
100 Years of QST 1915-2015

See p30 April 2015 QST

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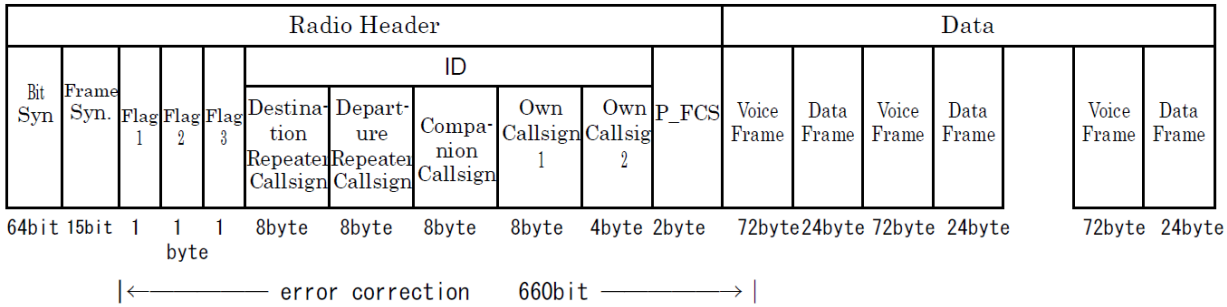
What is Digital Voice?

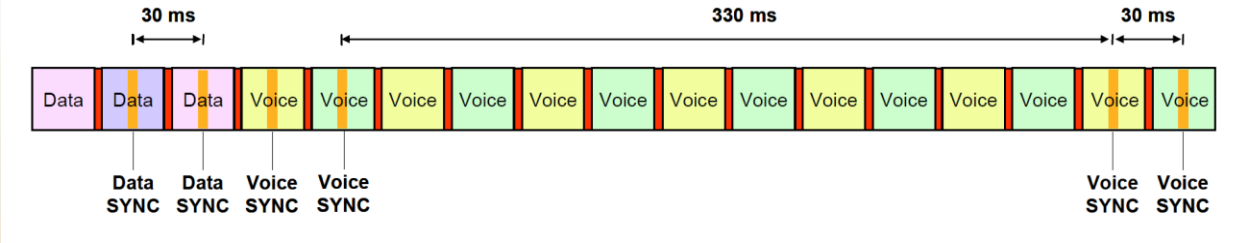
- Digital data modulating an RF carrier
- The data is digitized audio from an A/D converter
- It is processed through a vocoder to compress the data and add forward error correction
- The data is sent serially in uniform length packets
- Header data is pre-pended to provide sync bits, routing instructions and user identity
- Other data is often interleaved or substituted for the voice to send text, pictures or other files

Pictorial view

D-STAR



DMR



Fusion

FS	FICH	DCH (0)	VCH (0)	VeCH (0)	DCH (1)	VCH (1)	VeCH (1)	DCH (2)	VCH (2)	VeCH (2)	DCH (3)	VCH (3)	VeCH (3)	DCH (4)	VCH (4)	VeCH (4)	Number of bits
40	200	40	72	32	40	72	32	40	72	32	40	72	32	40	72	32	Total 960 bit

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Tech Spec Comparison

	D-STAR	DMR	Fusion
Vocoder (see note)	AMBE+	AMBE+2	AMBE+2
Forward Error Corr.	Voice Only	Voice Only	Voice Only
Modulation	GMSK	4FSK	C4FM
Multiplex Method	FDMA	TDMA	FDMA
Transmission Rate	4.8 kbps	4.8 kbps x 2	9.6 kbps
Bandwidth	6.25 kHz	12.5 kHz	12.5 kHz
Channels supported	1	2	1
Standard Developer	JARL	ETSI	Yaesu

GMSK = Gaussian Minimum Shift Keying
4FSK = 4-level Frequency Shift Keying
C4FM = Continuous 4-level Frequency Modulation
FDMA = Frequency Division Multiple Access
TDMA = Time Division Multiple Access

Note: Newer radios implement the vocoder in the DSP chip

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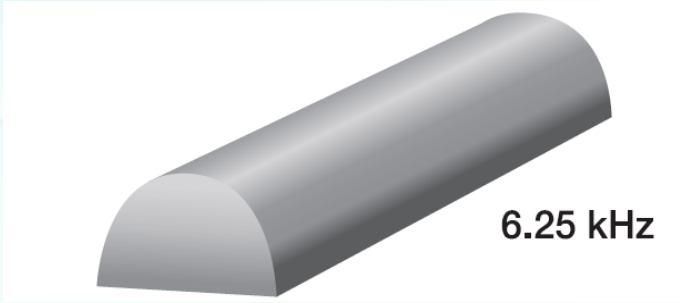
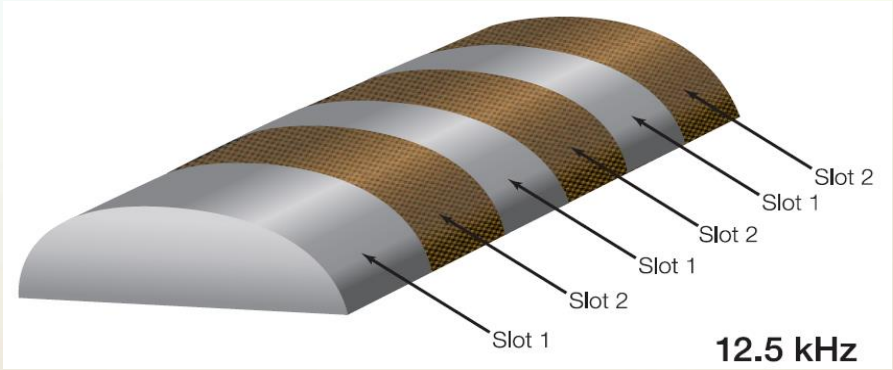
Bandwidth Comparison

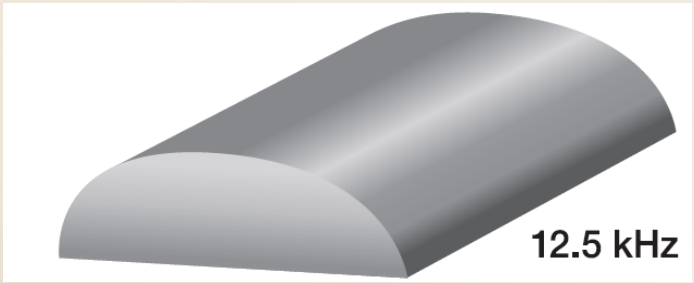
D-STAR



DMR



Fusion



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User Identification

	D-STAR	DMR	Fusion
Registration required?	Yes	Yes	No
User identity	Call sign	Subscriber ID	Call sign
ID displayed on radio's display	Call sign	Subscriber ID*	Call sign
Other text display options	4 characters 20 characters	No	No
Adequate for FCC ID?	Yes†	No	Yes†

* Call sign displayed if the receiving station's subscriber ID is in the radio's contact list; otherwise subscriber ID appears.

† IDing by voice is still a good idea for the benefit of everyone listening.

Repeater Connectability

	D-STAR	DMR	Fusion
Talk locally	Yes	Yes	Yes
Link to another repeater	Yes	No	No
Multi-repeater connection	Reflectors	Talk Groups	Rooms
Selection method	UR entry	Channel Dial	DTMF
Route to another ham	Yes	No	No
Echo test	Yes	Yes	No
Request link status	Yes	No	No

Radio Operating Features

	D-STAR	DMR	Fusion
Repeater channel selection	Dial	Dial	Dial
Repeater connection selection	Dial	Dial	DTMF code
Mode selection method	Key press	Program	Key press *
Radio programming complexity	Difficult/Easy ◊	Difficult	Easy
Newbie learning curve	Steep	Fairly easy	Easy
User manual pages - older HT	131 (IC-91)	65 (CS-700)	247 (FT-1D)
User manual pages - newer HT	425 (ID-51)		

* Fusion radios have AMS (automatic mode select)

◊ Older D-STAR radios are more difficult to program. Newer ones are pre-programmed, but must be updated occasionally as repeaters change.

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Signal Readability

	FM	D-STAR	DMR	Fusion
Voice naturalness	Good	Fair	Good	Best
Signal noise	Varies	None	None	None
Sync robustness	N/A	Fair	Good	Good
Sync recoverability	N/A	Poor	Best	Best

Sync robustness is the tendency to fall out of sync
Sync recoverability is the ability to recover sync quickly

The opinions shown here are highly subjective. Your opinion may be different.

Networking Characteristics

- D-STAR
  - User control capability – excellent
  - Networking options – G2, D-Plus, ircDDB
  - Innovation ability – many efforts and accomplishments
- DMR
  - Centrally controlled structure – inflexible
  - Networking options – c-bridge, hytera
  - Innovation ability – limited
- Fusion
  - Yaesu controlled servers – inflexible
  - Networking options – WIRES-X
  - Innovation ability –limited

D-STAR HT's

ID-31A

- Single band (70cm)
- 5W
- uSD card record
- 500 memories
- Internal GPS
- Repeater geo search
- $295 new

ID-51A Plus

- Dual band
- 5W
- uSD card record
- 1300 memories
- Internal GPS
- Repeater geo search
- $450 new

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D-STAR Mobile's

Older - ID-880H

- Dual band
- 50W
- 1050 memories
- $420 new

Newer - ID-5100A

- Dual band Touch Screen
- 50W
- 1000 + 1200 DR memories
- Internal GPS & DPRS
- uSD card recording
- Repeater geo search
- $600 new

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DMR HT's

MotoTrbo - XPR-7550

- 440 MHz band
- 4W
- 1000 channels
- $ 700 new

Hytera PD782G-U1

- 440 MHz band
- 4W
- 1024 channels
- $ 545 new

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DMR HT's (cont.)

Connect Systems - CS700

- 440 MHz band
- 4W
- 1000 memories
- $ 200 new

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DMR Mobile's

MotoTrbo - XPR-5550

- 440 MHz band
- 40W
- 1000 channels
- $ 600 new

Hytera - MD782G-U1

- 440 MHz band
- 45W
- 1024 channels
- $ 530 new

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System Fusion HT's

Yaesu - FT-1DR

- Dual band
- 5W
- Automatic Mode Select
- 900 memories
- GPS & APRS
- $300 new

Yaesu FT-2DR (new)

- Dual band
- 5W
- Automatic Mode Select
- 1245 channels
- GPS & APRS
- Touch screen
- $600 new

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System Fusion Mobile

Yaesu - FT-400DR

- Dual band
- 50W
- Automatic Mode Select
- 900 memories
- GPS & APRS
- Color Touch screen
- $400 new

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Other Digital Voice Suppliers

DV Dongle

- Internet Labs
- D-STAR on your PC
- $200 new

Thumb DV

- Northwest Digital Radio
- D-STAR on your PC
- Uses AMBE 3000
- Other modes?
- $120 new

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Other Digital Voice Devices

DV Access Point

- Internet Labs
- Hotspot repeater
- Single band
- 2M $240 new
  70 cm $260 new

DV Mega

- Guus van Dooren PE1PLM
- Hotspot repeater
- Dual band
- $180 new

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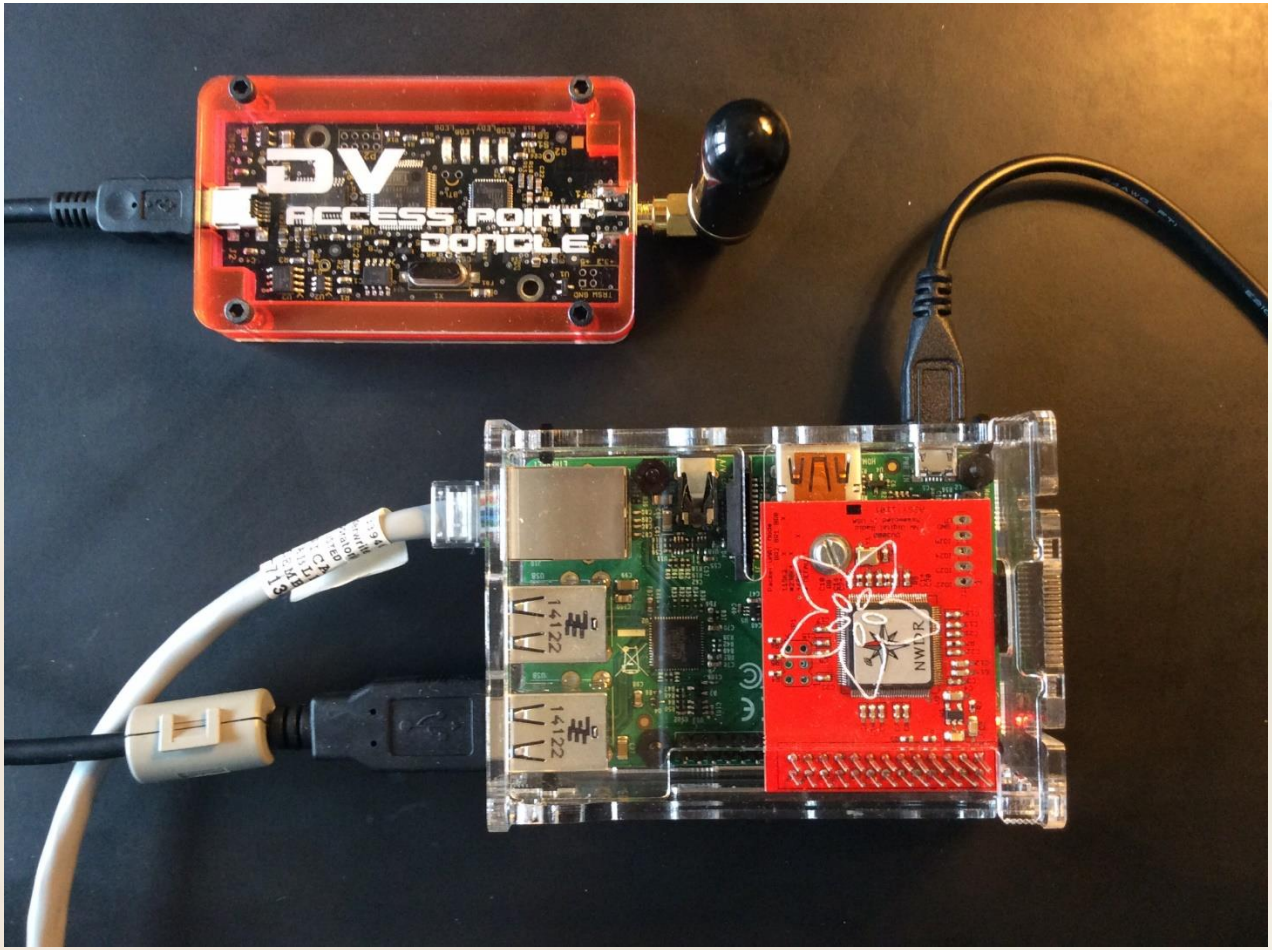
Not near a D-STAR Repeater? Make your own – with this…



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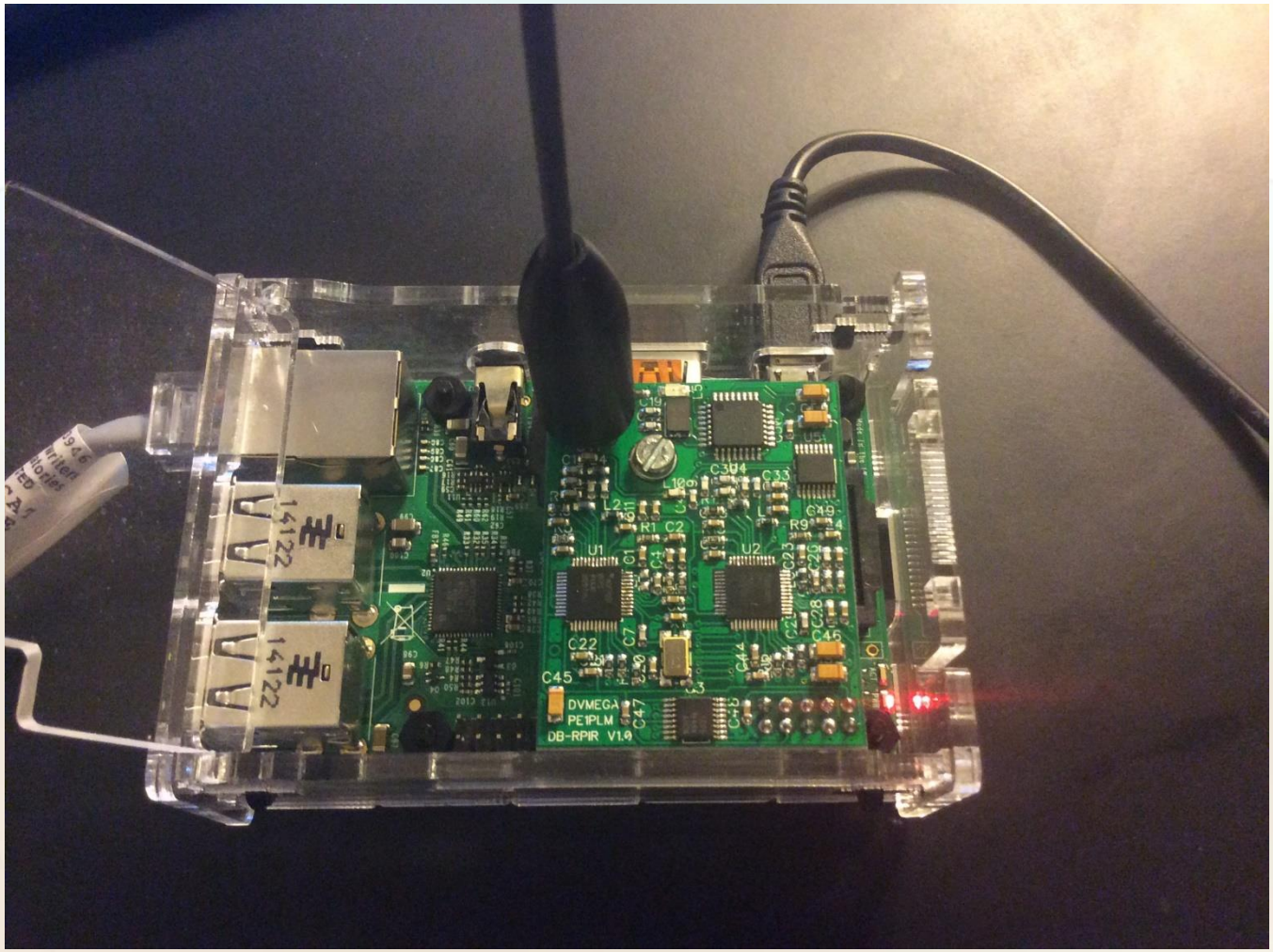
Or this…



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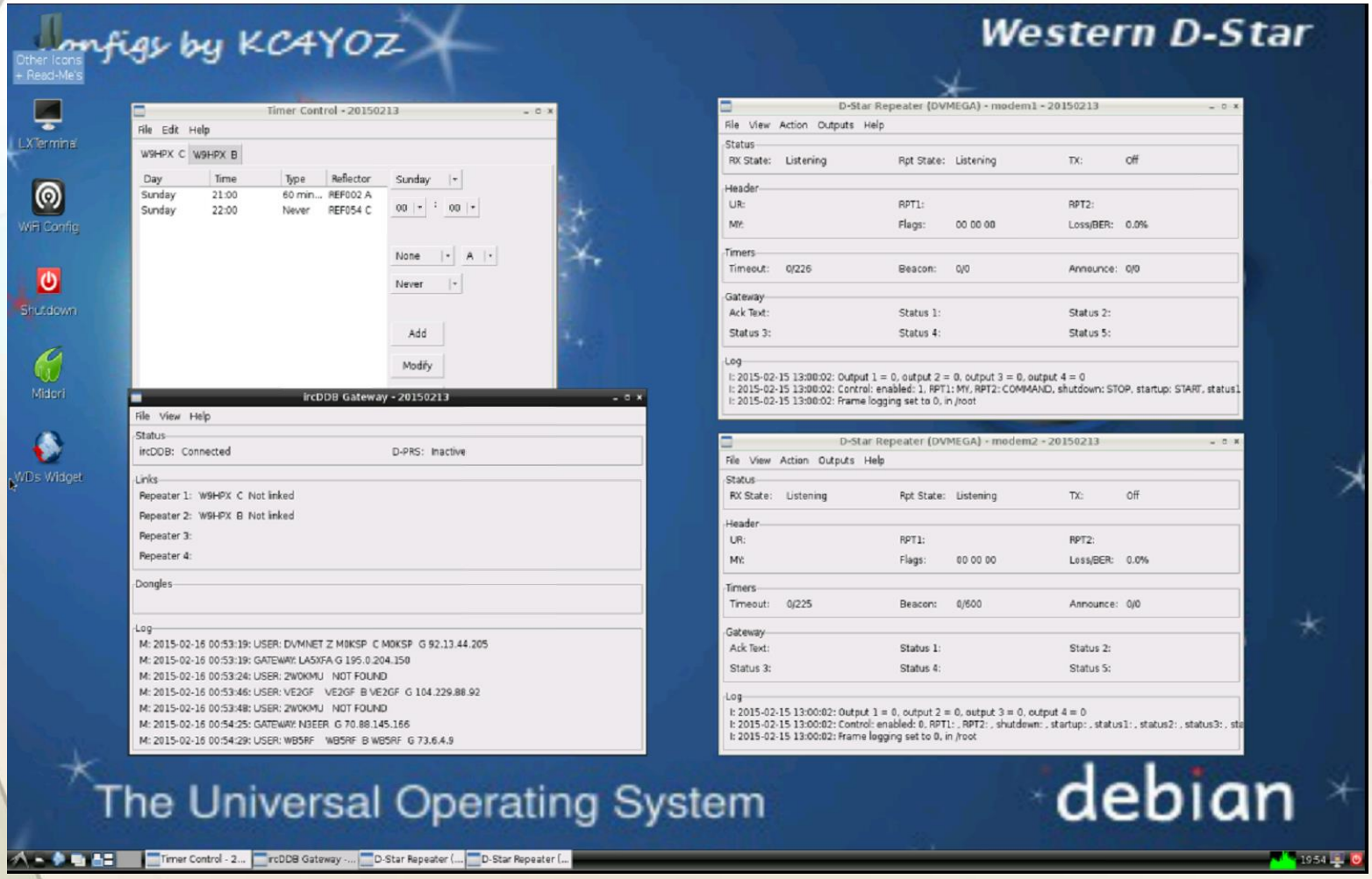
Raspberry Pi G4KLX GUI



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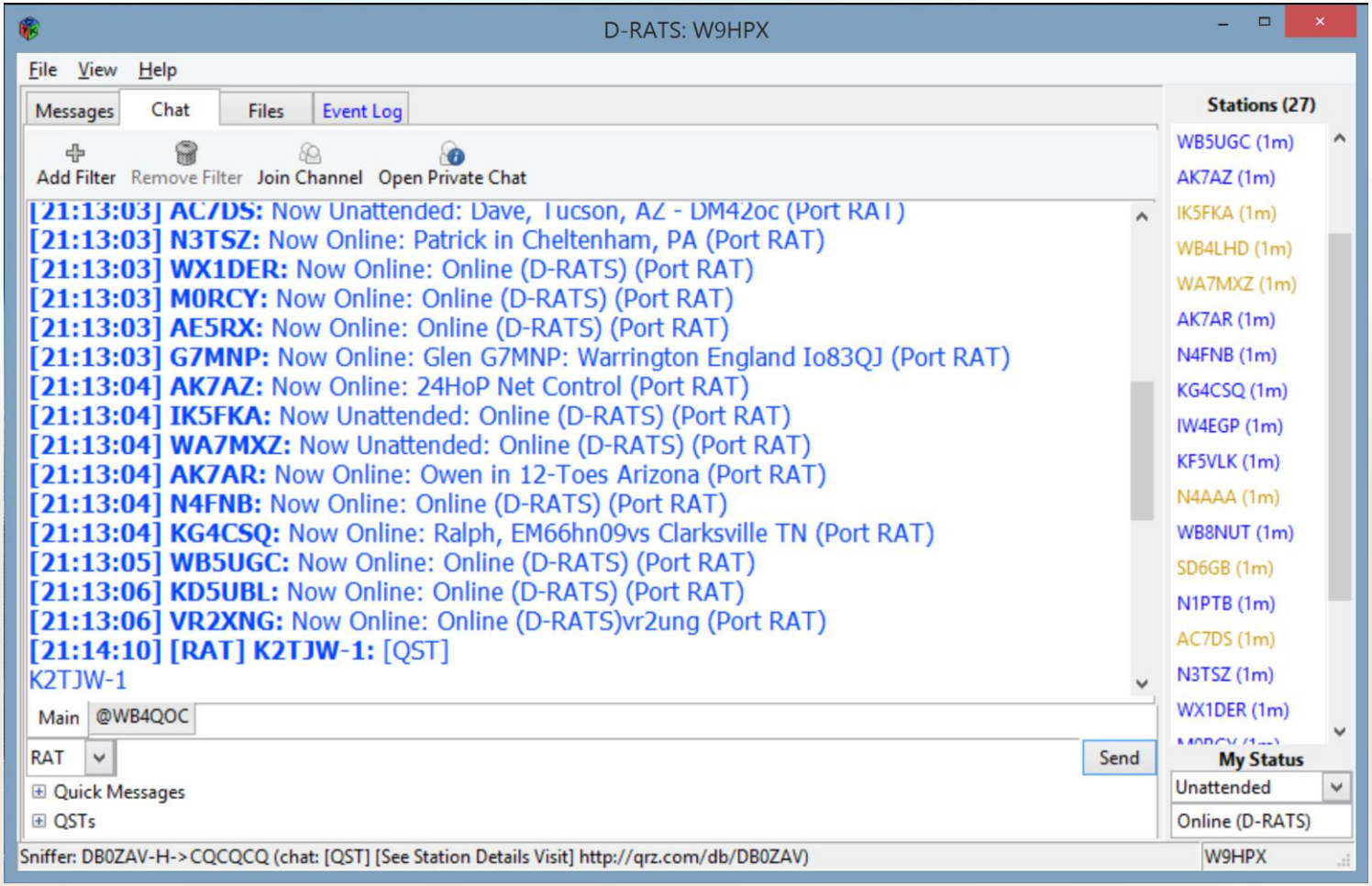
D-RATS


D-RATS: W9HPX
File View Help
Messages Chat Files Event Log
Add Filter Remove Filter Join Channel Open Private Chat
[21:13:03] AC7DS: Now Unattended: Dave, Tucson, AZ - DM42oc (Port RAT)
[21:13:03] N3TSZ: Now Online: Patrick in Cheltenham, PA (Port RAT)
[21:13:03] WX1DER: Now Online: Online (D-RATS) (Port RAT)
[21:13:03] M0RCY: Now Online: Online (D-RATS) (Port RAT)
[21:13:03] AE5RX: Now Online: Online (D-RATS) (Port RAT)
[21:13:03] G7MNP: Now Online: Glen G7MNP: Warrington England Io83QJ (Port RAT)
[21:13:04] AK7AZ: Now Online: 24HoP Net Control (Port RAT)
[21:13:04] IK5FKA: Now Unattended: Online (D-RATS) (Port RAT)
[21:13:04] WA7MXZ: Now Unattended: Online (D-RATS) (Port RAT)
[21:13:04] AK7AR: Now Online: Owen in 12-Toes Arizona (Port RAT)
[21:13:04] N4FNB: Now Online: Online (D-RATS) (Port RAT)
[21:13:04] KG4CSQ: Now Online: Ralph, EM66hn09vs Clarksville TN (Port RAT)
[21:13:05] WB5UGC: Now Online: Online (D-RATS) (Port RAT)
[21:13:06] KD5UBL: Now Online: Online (D-RATS) (Port RAT)
[21:13:06] VR2XNG: Now Online: Online (D-RATS)vr2ung (Port RAT)
[21:14:10] [RAT] K2TJW-1: [QST]
K2TJW-1
Main @WB4QOC
RAT
Send
Quick Messages
QSTs
Stations (27)
WB5UGC (1m)
AK7AZ (1m)
IK5FKA (1m)
WB4LHD (1m)
WA7MXZ (1m)
AK7AR (1m)
N4FNB (1m)
KG4CSQ (1m)
IW4EGP (1m)
KF5VLK (1m)
N4AAA (1m)
WB8NUT (1m)
SD6GB (1m)
N1PTB (1m)
AC7DS (1m)
N3TSZ (1m)
WX1DER (1m)
My Status
Unattended
Online (D-RATS)
Sniffer: DB0ZAV-H->CQCQCQ (chat: [QST] [See Station Details Visit] http://qrz.com/db/DB0ZAV)
W9HPX

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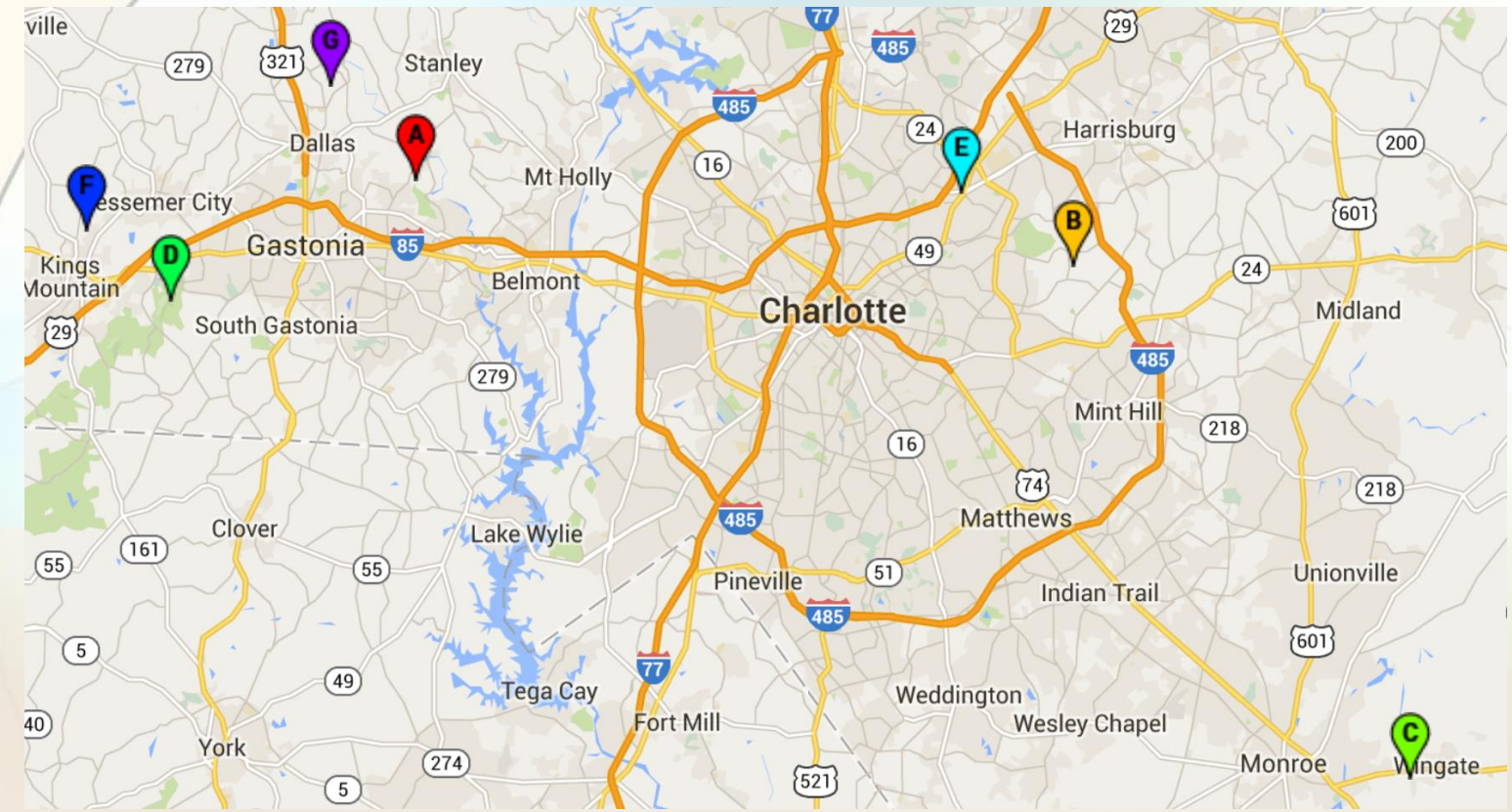
For More Information

- www.charlottedstar.org - This is our web site. Register for D-STAR.
- groups.yahoo.com/neo/groups/clt-dstar/info
  This is our Yahoo group, but search for other Yahoo groups of interest such as D-STAR, Fusion, DMR, Connect Systems, etc. There's many.
- www.dstar101.com
- www.dstarinfo.com
- www.dstarusers.org
- www.maryland-dstar.org - for Raspberry Pi enthusiasts
- www.ncprn.net - Web site for our area DMR repeaters & code plugs.
- www.dmr-marc.net
- www.trbo.org
- www.trinityos.com/HAM/Yaesu-System-Fusion/Yaesu-fusion-and-c4fm-v7.pdf - Talk given by David Ranch KI6ZHD at 2015 Bay-Net meeting.
- www.youtube.com/watch?v=C1ClH3R17m0 – Unscientific simplex field comparison.

Charlotte Area Digital Voice Repeater Locations



A – Spencer Mt. – D-STAR (70cm & 23cm), DMR (70cm Hytera), Fusion (70cm)
B – Hood Rd. – D-STAR (2M & 70cm & 23cm)
C – Wingate – D-STAR (70cm), DMR (70cm)
D – Crowder's Mt. – D-STAR (23cm), DMR (70cm), NexEdge (70cm)
E – Charlotte – DMR (70cm)
F – Shelby – D-STAR (2m & 70cm)
G – Charlotte (Dallas) DMR (33cm)

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Questions?

Be sure to visit us at Booth 22

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